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EFFECT OF A WATER SOLUBLE ORGANIC ADDITIVE ON GROWTH PERFORMANCES, HEMATOLOGICAL PARAMETERS AND COST EFFECTIVENESS IN BROILER PRODUCTION

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ABSTRACT

An experiment was conducted with 144 broiler chicks (Cobb 500) from day-old to five weeks of age to investigate the efficacy of a water additive in broiler production. The chicks were randomly distributed into four different treatments namely T_1 (control), T_2 (water additive as per recommended level of the manufacturer), T_3 (25% less than the recommendation) and T_4 (25% more than the recommendation). Broiler growth performances and hematological parameters were studied and cost effectiveness of the application of such water additive was determined. There was an improvement in both body weight and FCR due to addition of water additive although all productive performances in birds receiving treatments showed no significant differences from the control. Among the hematological parameters, lower values were obtained for mean cell volume and mean cell hemoglobin, although only the former (mean cell volume) of the treated groups differed significantly (P<0.05) from the control. However, all levels of water additive increased profit in comparison with the control but addition of the additive at a rate 25% less than the recommendation appeared to be most profitable and cost effective. It was therefore concluded that the water additive tested in this study may be applied 25% less than the usual recommendation. It also suggests that any additive considered for poultry, must undergo trial for determining efficacy as well as its cost effectiveness for application.

Key Words: Water additive, Growth performances, Broiler, Hematological parameters, Cost effectiveness

INTRODUCTION

High performing animals, reared under intensive production conditions, characterized by high stocking densities, tend to be susceptible to several diseases (Goddeeris, 2005). Such diseases may be caused by invasion of pathogens into livestock operations, alteration of

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feeding regimens, or harsh changes in ambient conditions (temperature and/or humidity), when the animals are exposed to a number of other stresses. The routine use of in-feed antibiotics in animal feeding has created growing public concern regarding bacterial resistance and residues in animal products such as meat, egg and milk (Domig, 2005). It is expected that the removal of antibiotic growth promoters is likely to create additional microbial pressure on the farms, which might result in lower growth rates and poorer feed conversion. Moreover, spreading of pathogenic germs might even cause an increase in the incidence of food-borne diseases in humans (Cervantes, 2006). Adequate management of gut health by nutritional means is supposed to be one of the main targets in modern animal or poultry nutrition. There is a general consent about the urgent need for alternative approaches to maintain animal health and performance levels, thus securing food safety. The use of natural growth promoter (NGP) like acidifier, probiotic, prebiotic, phytogenic etc. is regarded as key strategy to support gut health, to counteract pathogenic germs and to optimize digestive functions (Steiner, 2006).

Plant extracts contain a vast source of different molecules which have intrinsic bio-activities on animal physiology and metabolism. Such extracts are the ingredients of many commercial preparations currently used in animal production that have antimicrobial (Jamroz *et al.,* 2003 and Manzanilla *et al*., 2004), antioxidant (Ertas *et al*., 2005 and Cross *et al*., 2007), antitoxin effects (Azumi *et al*., 1997; Platel and Srinivasan, 2000) and are able to improve digestibility (Rao *et al*., 2003), stimulate enzyme activity (Platel *et al*., 2002) and immune functions (Watzl *et al*., 2005 and Ko and Yang, 2008). The results of previous studies indicated that the addition of plant product as feed additive may be considered as a potential NGP in broiler production (Alcicek *et al*, 2003; Çabuk *et al*., 2006 and Ertas *et al.,* 2005). It also affects growth performance, blood profile and meat quality parameters in pig and cattle (Lee *et al*., 2009 and Sarker *et al*., 2010). Muramidase can reduce or replace antibiotics used for growth promotion in broiler chicks (Sotirov *et al.,* 2000) by its anti bacterial properties and also improve feed efficiency. On the other hand, both muramidase and peroxidase decrease intestinal harmful bacteria, and animals therefore could have a better feed conversion. Fructooligosaccharide (FOS) increases the number and activity of beneficial bacteria in the colon of animals and poultry. It can be substituted for antibiotics to enhance the growth performance (Wu *et al.,* 1999) and to significantly increase average daily gain of broilers (Xu *et al.,* 2003). Vitamin E and Vitamin C promote improved resistance of body against infection and stress that improved feed utilization and feed conversion ratio (FCR) as well as decrease broiler mortality (Villar-Patino *et al*., 2002 and Ewa Sosnowka *et al.,* 2005).

Most of the studies on feed or water additive have dealt with either single or a combination of two or three active principles. Therefore, information regarding the efficacy of a blend of a number of active principles is scanty in the literature. The current study was an attempt to investigate the effect of a water soluble organic additive containing muramidase, peroxidase, oligosaccharide, vitamin E, vitamin C and plant extract as a NGP on the productive performances, hematological parameters and cost effectiveness of floor reared commercial broilers.

MATERIALS AND METHODS

Experimental design

The study was conducted with 144 day-old commercial broiler chicks (Cobb 500) for a period of five weeks. The chicks were randomly distributed into four different treatment groups namely, T_1 (control), T_2 (water soluble organic additive at recommended level), T_3 (25% less than the recommendation), T_4 (25% more than the recommendation) with three replications in each treatment. The composition of water additive is shown in Table 1. The number of birds in each replication was 12. The experimental house was divided into 12 small pens of equal size (120 cm × 90 cm) for housing 12 birds in each pen.

Feeding

Poultry feed that met the nutrient requirements of broiler chicks was supplied *ad libitum* throughout the experimental period. The birds were fed a starter diet containing 3000kcal ME/kg, 22.5, 4.5, 1.1 and 0.55% crude protein, ether extract, calcium and total phosphorus respectively up to 12 days. A finisher diet was fed during the subsequent period which contained 3100 kcal ME/kg, 22.0, 6.0, 1.2 and 0.65% crude protein, ether extract, calcium and total phosphorus respectively. Both the diets contained 89% dry matter and 5% crude fiber approximately. Feed was supplied in tray feeders every two hours interval during the early period of growth (10 days) and later three times daily on regular feeders providing adequate feeding space.

Management

The house was properly cleaned, washed and disinfected properly**.** All feeders, plastic buckets, waterers and other necessary equipments were also properly cleaned, washed and disinfected, subsequently dried and left them empty for a week before the arrival of chicks. Water additive was properly mixed with fresh, cool and clean drinking water and supplied to the experimental birds once in the morning and again in the afternoon. It was added to drinking water twice in a week at 1^{st}, 3^{rd} and 5^{th} week of age. Fresh, clean and dried rice husk was used as litter materials at a depth of about 3 cm. The litter was well covered by clean newspaper up to first 10 days. Upper part of the litter was removed twice in a week when found very dirty in subsequent days and/or regularly stirred for prevent cake formation. The litter and housing area were disinfected with a safe and suitable disinfectant in every alternate day. Any part of litter, when found wet for any reason, were replaced immediately by new litter materials to prevent dampness. Gunny bags were used on two sides of the house and in ventilators to protect cold and stormy wind for maintaining brooding temperature during early growth period. Care was taken to ensure proper ventilation with the advancement of age of birds. The birds were exposed to a continuous lighting of 23 hours and a dark period of 1 hour in 24 hours. They were vaccinated against Gumboro and Newcastle Disease. During the course of experiment, multi-vitamins, when required, were added to drinking water of birds of all treatments to combat stress due to high environmental temperature (33°C to 37°C). The use of multi vitamins in drinking has been proved to be useful and cost effective in broiler production (Saha *et al.*, 2010).

Table 1. Composition of water additive (per kg)

Constituents	Unit
Muramidase (Lysozyme)	5X108 SU
Peroxidase	120 gm
Fructooligosaccharide (Prebiotic)	30 gm
Herbal extract	390 gm
Vitamin E	2.5 gm
Vitamin C	150 gm

Hematological study

Five ml of blood was collected from jugular vein from three birds considering randomly from each group and stored in a sterilized test tube containing 0.5 ml anticoagulant sodium citrate (4%) at a ratio of 1:10. The hematological studies were performed within two hours of blood collection. The hematological parameters considered were total erythrocyte count (TEC), hemoglobin (Hb), packed cell volume (PCV), erythrocyte sedimentation rate (ESR), mean cell volume (MCV), mean cell hemoglobin concentration (MCHC) and mean cell hemoglobin (MCH).

Record keeping, statistical analysis and cost analysis

The temperature and humidity were recorded by an automatic digital thermo-hygrometer. Data collected during the experimental period were body weight and feed consumption while body weight gain and feed conversion were calculated from the recorded data. Analysis of data was performed using a statistical programme (SPSS, 2003) for one-way analysis of variance (ANOVA). Duncan's Multiple Range Test was employed to know the difference between the treatment means at 5% level of significance (Steel and Torrie, 1980). Data are presented as mean values ± standard error. Cost analysis was performed considering market price of inputs and outputs. Profitability was determined considering the cost incurred for water additive.

RESULTS AND DISCUSSION

Body weight and body weight gain

Although no significant differences ($P>0.05$) were observed among different treatments, both body weight and body weight gain tended to be higher in birds receiving the water additive (Table 2). The water additive tested in this study improved weight gain by 4.8, 7.6 and 7.5% due to its addition at recommended level, a level 25% less and 25% more respectively. It appears from such a result that increasing or decreasing the level of the water additive by 25% from the recommended level may be equally effective for growth promotion of broilers.

Results of the application of phytobiotics in the nutrition of broiler chickens are not completely consistent. Some authors state significant positive effects on broiler performance (Ertas *et al.,* 2005) whereas others found no differences (Cross *et al.,* 2007). Fukata (1999) and Wu *et al.* (1999) reported increased growth rate as a consequence of fructooligosaccharide (FOS) inclusion in broiler diets whereas Waldroup *et al.* (1993) found that the addition of FOS to nutritionally complete broiler diets at 0.38% had little consistence effect on growth rate. The current findings also resembled to the findings of Ewa Sosnowka *et al.* (2005) and Bhat *et al.* (1999) who found no significant difference on growth rate between treatment group and control due to addition of vitamin E and C in the diet. Alcicek *et al.* (2003) evaluated an herbal extract and stated that it may be considered as a potential growth promoter in broiler production. But this finding was not in agreement with Williams *et al.* (2008) who reported that FOS reduced daily live weight gain.

Feed intake, feed conversion ratio and mortality

Table 2 shows that feed intake was significantly reduced when the water additive was applied 25% more than the recommended level while birds receiving other two treatments (standard dose and 25% less) showed results similar to the control. A decreasing trend in values of FCR was observed in all water additive treated groups although the results did not differ significantly from the control. This result resembled to the earlier findings of Ewa Sosnowka *et al.* (2005) and Sirbue *et al.* (1986) who found no significant difference in feed conversion in birds fed vitamin E while Villar-Patino *et al.* (2002) stated that vitamin C supplemented diets resulted in lower feed consumption and lower rates of feed conversion. They also suggested that vitamin E supplemented diets resulted in better growth performance and lower rates of feed conversion. In addition, Humphrey *et al.* (2002) stated that muramidase (lysozyme) significantly lowered feed intake and improved feed efficiency than those fed the control diet. Lower feed intake was also reported by Williams *et al.* (2008) and Çabuk *et al.* (2006) who observed that the birds given FOS and essential oil mixtures (herbal extract) had a lower feed intake as compared to control. There was no mortality in any group during the experimental period.

Table 2. Performance characteristics of broilers receiving water additive (0-5 weeks)

Variables	T_1	T_2	T_3	T_4
Initial body weight (gm)	38.3 ± 0.00	39.1 ± 0.72	40.3 ± 1.21	39.4 ± 1.39
Final body weight (gm)	1475.0 ± 40.47	1573.6 ± 46.42	1587.5 ± 28.36	1583.4 ± 22.06
Body weight gain (gm)	1436.7 ± 40.47	1505.2 ± 34.43	1547.2 ± 29.29	1545.0 ± 22.05
Feed intake (gm)	2810.9^{ab} ± 4.02	2807.3^{b} ± 1.58	2817.4^{a} ± 2.35	2795.2^{c} ± 0.85
FCR	1.96 ± 0.060	1.83 ± 0.060	1.82 ± 0.035	1.81 ± 0.030

T_1 = control; T_2 = water additive as per recommendation; T_3 = water additive 25% less than the recommendation and T_4 = water additive 25% more than the recommendation. Values indicate mean ± SE ^{a,b} Means with uncommon superscripts in a same row are significantly different (P<0.05)

Hematological parameters

The results of hematological parameters are displayed in Table 3. The values of TEC in all treated birds were significantly (P<0.05) higher than the values of control group. The highest value of TEC was in T_4 group and lowest in T_1 (control) group. The difference in hemoglobin (Hb) content between T_2 and T_3 groups was statistically significant and T_3 group showed the highest value. The highest PCV value was found in T_4 group which differed from that of control (P<0.05). Although no significant difference in hemoglobin content was apparent at 25% higher or lower level of supplementation, PCV value increased when the test material was supplied at 25 % more than the recommendation. There was a tendency of higher values of both PCV and hemoglobin contents in the treated groups. This result caused an improved FCR of broilers (Table 2). This result has got support from Miruka and Rawnsley (1997). Mean cell volume (MCV) and mean cell hemoglobin (MCH) in birds receiving additive at different doses differed significantly (P<0.05) from the control. Men-Kin *et al.* (1994) found increased blood Hb and erythrocyte count due to addition of vitamin C in the diet. A significant positive correlation had also been found between hemoglobin content and body weight of fowls (Singh *et al.*, 1998) and Cetin *et al.* (2005). Baidy *et al.* (1994) observed no significant effects on the hematological parameters following the supplementation of enzyme, antibiotics and probiotic in broiler diet. The changes as observed in this study might be due to the initiative effects on hemopoitic organ that were more active and developed in additive groups than that of control and the digestive system became well balanced to absorb proper level of essential nutrients which are needed for erythropoiesis.

Table 3. Hematological parameters of broilers treated with different levels of water additive

Variables	T_1	T_2	T_3	T_4
Packed cell volume (PCV)	$23.99^{b} \pm 0.66$	$24.87^{ab} \pm 1.28$	$26.87^{ab} \pm 1.07$	$27.78^{a} \pm 0.49$
Total erythrocyte count (TEC)	$1.64^{c} \pm 0.09$	$2.18^{b} \pm 0.05$	$2.14^{b} \pm 0.05$	$2.47^{a} \pm 0.03$
Hemoglobin (Hb)	$8.07^{ab} \pm 0.09$	$7.33^{b} \pm 0.03$	$8.75^{a} \pm 0.37$	$8.21^{ab} \pm 0.48$
Erythrocyte sedimentation rate (ESR)	1.78 ± 0.22	2.00 ± 0.00	1.78 ± 0.40	1.89 ± 0.11
Mean cell volume (MCV)	$147.07^{a} \pm 7.75$	$113.88^{b} \pm 4.60$	$125.63^{b} \pm 7.14$	$112.69^{b} \pm 3.20$
Mean cell hemoglobin concentration (MCHC)	33.68 ± 0.91	29.64 ± 1.53	32.59 ± 0.84	29.55 ± 1.55
Mean cell hemoglobin (MCH)	$49.48^{a} \pm 2.50$	$33.62^{c} \pm 0.62$	$40.88^{b} \pm 1.94$	$33.33^{c} \pm 2.28$

T_1 = control; T_2 = water additive as per recommendation; T_3 = water additive 25% less than the recommendation and T_4 = water additive 25% more than the recommendation. Values indicate ± mean SE, ^{a,b} Means with uncommon superscripts in a row are significantly different (P<0.05).

Cost analysis

The results of cost analysis are presented in Table 4. Production cost involved cost of bird, feed, water additive and maintenance (disinfectant, vaccine, transport, labor, water and electricity). The feed cost (cost/bird) was the highest (BDT 73.25) in group T_3 and lowest

(BDT 72.67) in group T_4. The feed cost and the total cost of production of birds receiving additive significantly varied from the control ($P<0.05$). Lowest cost (BDT 128.03) was found in control group while the additive groups showed the higher cost (BDT 130 approximately) as would be expected. When sale price/bird was considered, it was found that the additive groups had higher values than the control as because birds of these groups had better body weight. In case of profit/bird, higher profit was found in additive groups which were BDT 27.29, BDT 28.88 and BDT 28.07 per broiler in T_2, T_3 and T_4 respectively. The profit per kg live broiler was highest in T_3 over that of control (BDT 5.00 approximately), the group that received additive less than 25% of the recommended level (Table 4).

Table 4. Cost analysis of broilers fed on different levels of water additive

Week	T_1	T_2	T_3	T_4
Feed Cost (BDT /broiler)	$73.03^b \pm 0.54$	$72.89^c \pm 0.01$	$73.25^a \pm 0.57$	$72.67^d \pm 0.02$
Additive cost (BDT/broiler)	0	2.18	1.64	2.73
Total Cost (BDT)	$128.03^d \pm 0.56$	$130.07^b \pm 0.01$	$129.89^c \pm 0.55$	$130.40^a \pm 0.02$
Sales price (BDT /broiler)	147.51 ± 4.04	157.36 ± 4.64	158.77 ± 2.86	158.47 ± 2.23
Profit (BDT /broiler)	19.48 ± 4.08	27.29 ± 4.65	28.88 ± 2.87	28.07 ± 2.22
Profit (BDT /kg broiler)	13.20 ± 2.36	17.34 ± 2.50	18.19 ± 1.5	17.72 ± 1.16
Profit over control (BDT/kg broiler	–	4.14	4.99	4.53

T_1 = Control; T_2 = Water additive as per recommendation; T_3 = Water additive 25% less than the recommendation and T_4 = Water additive 25% more than the recommendation. ^{a,b,c,d} Means with different superscripts within a same row are significantly different ($P<0.05$).

CONCLUSIONS

It may be concluded that the productive performances of broilers treated with water additive 25% less or more than the recommended levels were similar to control. There was no adverse effect of the test material on hematological parameters of broiler that could affect productivity and profitability. Though addition of additive in water increased the production cost of broiler, return in terms of profitability supports its inclusion but a level less than 25% of the recommendation provides highest profit and therefore most cost effective. The study also suggests that feed or water additive considered for poultry, must undergo trials to determine efficacy, correct dose as well as its cost effectiveness.

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